Price-quality relation in tenders

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It is commonly assumed better quality comes at a cost, so higher quality products have a higher price. Here we investigate that assumption in the context of business to business public procurement. We use data from 400 real tenders.
Results indicate there is a weak negative price-quality correlation, indicating higher quality is associated with lower prices. Data shows 30.6% of all winning tenders have the best score both on quality as well as the best score on price.
These findings provide evidence to believe some companies have a good brand-image, or have structured its supply chain in such a way they can provide its customers high-quality products for a low price.
Statistical tests performed on different subgroups pointed out the relation between price and quality does not vary across those groups: the difference between 'product or service' and 'weight of price and quality' most likely does not heavily influence the price-quality relation.

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1. INTRODUCTION

It is commonly accepted that there is a relationship between price and quality. Several studies mention that consumers assume that a higher price signals better quality. Even though it is recognized there are other factors influencing price (Gerstner, 1985; Stiglitz, 1987) others back up the assumption of the consumers by mentioning that it is almost impossible for low-quality companies to sell their products for a high price since consumers become more and more informed of the quality of the product (Archibald, Haulman, & Moody, Jr., 1983; Bagwell & Riordan, 1991). (Tellis & Wernefelt, 1987) mention the increasing number of brands to choose from and the increasing number of dimensions to evaluate them, drives consumers to consider price as an indicator of quality.

Even though most of these studies have their emphasis on business to customer buying, in business to business buying the same issue occurs. Companies still tend to believe a higher price is related to better quality.

However some studies conducted in the field of price-quality correlation report a negative correlation, which they attribute to an imperfect market (Curry & Riesz, 1988; Lichtenstein & Burton, 1989). We suggest there might be another explanation for this negative correlation; when an organization has a well-functioning, efficient production process it is both capable of offering high quality products while at the same time having lower production costs than competitors. Therefore high quality products can be offered for a lower price as a result of an efficient and well managed production process. Another reason can be a well-established brand image of the organization. When customers are already aware of the organization selling high quality products the need for advertising lowers. Besides the advantage on advertisement customers are also more willing to wait for the product resulting in lower inventory costs. Both these advantages lead to less costs for the organization enabling it to sell high quality products for a lower price.

Here we want to investigate these differing opinions on empirical data on the price-quality relation. We have access to a large database with hundreds of public tenders including the weight of price and quality, the price, quality points, and nature of the product.

2. INITIAL ANALYSIS

The database that will be analyzed contains anonymized information on hundreds of tenders. It includes tenders from different governmental levels on services and products. It shows the price and quality points of each bid, but also the weights that are set by the buying organization, the nature of the product or service and which bid has won. Since the focus of this research is only on the relation between price and quality and not on other factors, we consider just one quality measure which may be a combination of all quality points for different aspects of the product.

With this data we want to investigate what the direction of the price-quality correlation is. We can do so in general for all bids received, but also for the winning bid only. We can further refine the analysis by narrowing down the data into different groups based on price level, importance of quality, and service or product.

It has to be taken into account that there are some limitations. Other factors of which we do not have any data of might influence the correlation between price and quality. Furthermore there might be companies that do not really take their time in making an offer. This results in some bids that have really high prices and low or average quality which cause outliers in the data.

2.1 Research problem

This research paper is aimed at investigating the direction of the price-quality correlation. A positive relation is one might expect; a higher quality requires better and more expensive materials and production processes which result in a higher price. The negative relation has three possible explanations; imperfect markets which enable organization to "cheat", the fact that higher quality products need a better and more efficient production process which consequently causes a cheaper production process due to less mistakes and a higher speed, so the price can be lower, and a well-established brand image causing less advertisement and inventory costs. By investigating the direction we want to find out if there is any reason for further investigation in the reason on the direction on price and quality.

The following research question is investigated:

"What is the direction of the price-quality correlation of bids in tenders in The Netherlands?"

In order to find out what the relationship is we will use real tender data including weights of price and quality, price, quality points and the type of products or service. This data is obtained from an organization located in The Netherlands. This organization has an online procurement platform mainly used for placing tenders by (semi-)governmental organizations.

2.2 Academic and practical relevance

Tenders are especially interesting in this case since the Public Procurement Act entered into force in the Netherlands in 2013 which obliged all (semi-)governmental organizations, with few exceptions, to use Economical Most Advantageous Tender (EMAT) as contract-awarding criterion for supplier selection. Contrary to the Lowest Tender (LT) criterion – which is solely based on price – EMAT includes both price and quality (Bergman & Lundberg, 2013). Furthermore these public organizations are required to be transparent in their contract-awarding criteria and scoring rule (Mateus, Ferreira, & Carreira, 2010).

In The Netherlands the public sector procures for around 20% of the GDP, which is around €100 billion (Onderstal, 2012). Since the Public Procurement Act forces (semi-)governmental organizations to use tenders for products or services that fit certain characteristics a large share of this €100 billion is procured by placing tenders. Therefor it is relevant to investigate the price quality relationship for products in tenders.

Besides the practical relevance this research also has academic relevance. First it provides an answer to the research question: "*What is the direction of the price-quality correlation of bids in tenders?"*. Second, the results of this research might put the economic backgrounds on propositions on organizational behavior in another perspective.

2.3 Structure

First relevant theory and information to answer the research question will be discussed. In this part earlier findings on the price-quality correlation will be mentioned as well as some assumptions made on the direction of the price-quality correlation. Then the method of the analysis will be set out. This analysis is separated into two different chapters. The first concerns the overall analysis, the second a specific analysis. The results will be presented, this part will again be split up into an overall and specific analysis. In the last part the implications, limitations and conclusion will be mentioned.

3. THEORY

Both price and quality are used as strategic options by product managers (Curry & Riesz, 1988). Historically these two options could not be seen apart; price was the mirror image of the quality of a product. This view does no longer exist since many studies assessing the relation of price and quality have found that the overall relationship between price and "objective" quality – which can be defined as "unbiased measurement of quality based on characteristics such as design, durability, performance, and safety" (Riesz, 1979) – is only weakly correlated. (Oxenfeldt, 1950) found an average price-"objective" quality correlation of .25 across a sample of 35 durable product categories. Combining results of (Gerstner, 1985), (Oxenfeldt, 1950), and (Tellis & Wernefelt, 1987) results in a mean correlation of 0.27 with a wide range over product categories (Vlaev, Chater, Lewis, & Davies, 2009).

Literature on this relationship offers several interpretations which possibly explain the weak price-"objective" quality correlation (Kirchler, Fischer, & Hölzl, 2010). The first states that the weak correlation is an indicator of an imperfect market (Morris & Bronson, 1969). According to (Gerstner, 1985) imperfect markets especially occur in situations in which consumers are not fully informed, or do not have access to all the required information. In perfect markets competition and learning consumers should eliminate high priced/low quality products. This interpretation has gained criticism on the fact that the price-quality correlation cannot be used to judge market behavior because this relationship says nothing about the frequency these products are bought (Ratchford, Agrawal, Grimm, & Srinivasan, 1996). Furthermore prices are in the first place indicators of scarcity, not of quality (Ratchford et al., 1996; Yamada & Ackerman, 1984).

The second explanation is strongly related to the first. Asymmetric information enables the seller to "cheat". Due to the fact that consumers often use price as an incentive to judge quality (Leavitt, 1954; Rao & Monroe, 1989; Tull, Boring, & Gonsior, 1964), they are able to sell products for a high price which makes consumers believe they choose a high quality product. Especially in service markets this is true, because it is really hard to objectively measure quality of services (Völckner & Hofmann, 2007). Many studies suggest it is unwise to use price as a cue for quality due to the weak correlation of price and quality. (Morris & Bronson, 1969): "results indicate that price and [objective] quality do correlate, but at a level so low as to lack practical significance." (Sproles, 1977) states that "study results suggest that consumer's conventional wisdom of 'you get what you pay' suffers a challenge." (Riesz, 1979) concludes that "consumer reliance on price as an indicator of product quality is an unwise purchasing strategy." Nevertheless quality is not a unidimensional concept, consumers might use price as an incentive to judge some concepts of quality. For these aspects the price might be the right cue and using price as an incentive to judge quality would not influence the price-quality correlation (Hjorth-Andersen, 1992). Furthermore (Völckner & Hofmann, 2007) state in their research that price is less frequently used as a cue for quality and (Gardner, 1971) concludes that unless price is the only information given, it does not influence the perception of quality.

Even though the overall relationship is weak, in some product categories there is a stronger correlation between price and quality. Non-durable products have a stronger price-quality correlation than durable products just like expensive products have a stronger price-quality correlation than cheaper products (Gerstner, 1985; Lichtenstein & Burton, 1989). This can be explained by the customers being more careful in making their decision which shows in doing more research resulting in more informed consumers, and thus a better function market. However these studies might have been statistically significant, (Hanf & Wersebe von, 1994) found that the price-quality correlation is weakly correlated to price level.

Next to investigating the correlation between price and quality and explain the variations, there is not many research conducted on why there is such a weak positive relationship and if there might be any other explanations besides an imperfect market (Curry & Riesz, 1988; Lichtenstein & Burton, 1989). Furthermore most of the researchers just focused on the positive correlation and saw a negative correlation as a consequence of an imperfect functioning market (Curry & Riesz, 1988; Lichtenstein & Burton, 1989; Tellis & Wernefelt, 1987). From the moment these papers were written until now some important changes in the market have taken place. The design of the supply chain – which can be defined as "an integrated process wherein a number of various business entities work together in an effort to: (1) acquire raw materials, (2) convert these raw materials into specified final products, and (3) deliver these final products to retailers" – has become more important as production costs are rising, resources are shrinking, product life cycles are shorter, and increasing globalization of markets (Beamon, 1998). Ever since the importance of the design of a supply chain was more and more recognized the attention paid to the price-quality correlation strongly decreased. This recognition might have caused a change in the price-quality correlation. When a company has an efficient production process which fits to its environment that company is able to put an advantage over its competitors (Lee, 2004) by producing high quality products at lower production costs. Therefore the price-quality correlation might be negative instead of positive.

Another reason that might explain a negative correlation is the image of a product and consumers being aware of this image. A manufacturer which is already known for its high quality products has less advertisement costs since potential customers are already aware of it. Furthermore, since a good brand image increases the perceived quality customers are willing to wait for a longer period of time to get that certain product because they really want it (Macdonald & Sharp, 2003). This results in lower inventory costs. So a good product image also might cause a negative correlation between price and quality.

4. ISSUES TO BE TESTED

The assumption of negative or positive relations may hold for either the entire set of bids or for the winning bid only. We distinguish these two situations in our tests and analyses.

4.1 There is an overall negative correlation between price and quality

The correlation in the entire set of bids can be either positive, meaning that if there is a better quality the price is also higher, or negative; lower prices for higher quality products.

We will test the direction of the correlation using three different measures. The first is an overall analysis of the price-quality correlation in the tenders. By creating a picture of the data using a scatterplot it will be clear how the relationship looks and based on that further statistical analyses are chosen. These scatterplots will have the quality point on the X-axis and the price-points on the Y-axis. As we expect these scatterplots to show many outliers and no clear linear relationship between price and quality a Spearman's Rho test will be used to calculate the price-quality correlation.

Once the overall correlation is known two other tests will be conducted in order to verify the outcome of the overall calculation. For each tender a scatterplot including a line-of-fit will be created. This visualization in combination with the line-of-fit makes it possible to place the tender in one of the following three scenarios: (1) the scatters show a positive linear relationship between price and quality; (2) there is no clear pattern visible in the scatters; and (3) the scatters show a negative linear relationship between price and quality. The number of tenders placed in each scenario will be counted. This will give an indication on how often a negative or positive correlation occurs in a tender.

Besides the scatterplot both the Pearson correlation and Spearman's Rho will be requested for each tender. Both showing results on the direction of the price-quality correlation. These directions will be used to place the tender in one of the following three categories: (1) both tests have a positive outcome; (2) the outcome of the tests differ; and (3) both tests have a negative outcome. The number of tenders placed in each of the situations will be counted. The outcome of this test should be more or less the same as the outcome of the previous test.

4.2 The winning bids are able of producing high quality products for a low price.

In order to test this assumption two groups will be created, one group for winning bids and one for the others. Two scatterplots, the first including bids of only the tenders with four bids or more, and the second including tenders with ten bids or more, will be created. These scatterplots have a special characteristic in comparison with those created to test the first assumption because these show which dots are representing winning bids. Since quality is placed on the x-axis with a range from $0 - 100$ (100 being the best score) and price is placed on the y-axis with a range from $100 - 350$ (100 being the best score) the best place to be is in the lower right corner. If our assumption is true a large amount of winning bids should be in this lower right corner.

In order to clarify the scatterplots a frequency table of the quality points and price points for both groups can provide an impression of the likelihood of the winning bid being systematically better in quality and lower in price than the other bids. Furthermore we can show the frequency of how often it occurs that a winning bid has the lowest price, highest quality, or even both. In case the winning bids have both the lowest price and the highest quality often, that might be evidence that backs up this assumption.

5. SPECIFIC ANALYSES

The overall analysis has showed some results which possibly can be explained by a specific analysis creating groups based on some variables. It may be the case we cannot draw any conclusions on the entire set of tenders, but a certain relation can still be valid for a specific subset of the data. We have access to data based on product nature; if it is a product or a service, and the importance of quality and price. Since we do not have access to other variables we are not able to use those. This might limit the results. However it is still interesting how the results differ when different groups based on different variables are created.

5.1 The direction of the price-quality correlation is different for products and services.

We just compare products and services with each other, since works are not included in our database. Our assumption on the negative correlation between price and quality is partly based on the efficiency of production process we assume that products have a more negative correlation than services. Examples of services in the database are the processing of garbage, juridical help, or temporary employees. The production processes of these services or not very complex. On the other hand examples of products are furniture, computers, printers, and food packages. Not all production processes are equally important and complex but overall the production processes will have a larger influence on the cost price. Therefor the price-quality correlation will most likely be more negative for products than for services.

Before we were able to perform the statistical tests the tenders had to be divided into two groups, one called 'products' and one called 'services'. This categorization was based on the nature of the tender available in the data. For both groups the same tests will be performed as in the overall analysis. We will calculate the Spearman's Rho for each group, divide the tenders into the three different scenarios based on the scatterplots, and divide the tenders into the three different situations based on the outcome of the Pearson correlation and Spearman's Rho tests. The results per group will be compared with each other. Especially the tables containing the frequencies of the tenders per scenario and situation are interesting since these differences can be tested on significance using a Chi-Square test.

5.2 The direction of the price-quality correlation is influenced by the weight of quality.

This assumption directly investigates how the direction is influenced by the weight of quality since these two together always have a sum of 100%. So if weight of price would be X and the weight of quality Y, $X + Y = 100$ and $100 - Y = X$.

If the weight of quality is larger than the weight of price, offering a higher quality becomes more important. In this case the winning tender will most likely have the best quality score. If a tender more heavily weights price over quality the winning bids will most likely has the lowest price. It gets interesting if the weights are equal to each other. An organization has to make sure it is able to offer a low price and high quality if it wants to make a chance to win. We assume that in this case the price-quality correlation most likely has the strongest negative price-quality correlation. Besides we also believe this group contains the largest amount of tenders having a winning bid that has both the best score on price and quality.

To test this assumption the same tests to find differences between services and products will be used. Only this time to compare three groups instead of two. Furthermore descriptive statistics on the frequency of winning bids having both the best price and quality score will be shown per group.

6. THE DATABASE

After the product classes are identified the databases obtained from Negometrix will be converted into SPSS. This dataset contains information on the nature of the product, the winning bid, the price, the quality points, and the weight of price and quality. The winning bid is calculated using the EMAT-method. Quality points are determined by an on beforehand decided measurement. The purchasing company decides which aspects of quality they want to include and set weights to these aspects. This information is open to the sellers, so every organization has access to the same information and is able to participate on it.

To compare price and quality and find out how they relate to each other the price and quality have to be normalized. At the moment the database contains the actual price, and quality points. The actual price will be converted into price points by dividing per tender all the prices with the best price for that tender, then it will be multiplied by 100. This will be done for every tender. Since it is required for some statistical tests the quality points are also normalized in the same way as price. This results in the quality ranging from 0% until 100%, 100% being the best score and the price points having a best score of 100.

$$\frac{Price\ Product\ X}{Lowest\ price} \times 100; \quad \frac{Quality\ product\ X}{Highest\ quality} \times 100$$

Besides the obtained database a new database was created in order to easier perform some statistical tests. This database includes the following variables: (1) tender number; (2) tender nature; (3) weight of price; (4) weight of quality, (5) scenario number, (6) Spearman's Rho, (7) significance of the Spearman's Rho, (8) Pearson's correlation, (9) significance of the Pearson's correlation, (10) winning bid having the lowest price, (11) winning bid having the best quality score, and (12) winning bid having both the best quality and price score.

7. STATISTICAL METHOD

Before any statistical test will be conducted descriptive statistics for several different variables will be requested and analyzed. These variables are price points to see how often any price score has occurred, quality points for the same reason as for price points, the number of bids per tender in order to define which tenders will be included in the statistical tests, and the weight of price and quality to create equal groups. Some of the statistical findings will help to create groups or set limitations. The first limitation is the maximum of the price points, a score of 350 or more is seen as an outlier since only two percent of the bids has a price score above this limit. The other is that there will be a minimum bid per tender criterion in some statistical tests that will be performed to make sure the relatively high influence of the winning bid does not affect the statistical outcome. This minimum number of bids will be at least four. In some cases the same test is also conducted for tenders with at least ten bids in order to test if the outcome would be the same.

First we will perform an overall analysis in which we investigate the price-quality correlation of bids on all tenders with at least four bids. In the overall analysis the assumption that winning tenders are able of producing high-quality products for a low price will also be tested. In order to test the first assumption "there will be an overall negative correlation between price and quality" both the obtained and created databases will be used. Since the obtained database contains data on the price and quality score for all the bids in each tender this database will be used to create a scatterplot for each tender, as well as two overall scatterplots where the first scatterplot includes all the tenders with at least for bids and the second includes all tenders with at least ten bids. These scatterplots will give a first impression on how price and quality relate to each other. The scatterplots per tender will include a line-of-fit. This will be a linear line to be able to see what the direction of the data is. If R^2 of the line-of-fit is 0.1 or bigger the direction of the tender will be obtained from the scatterplot, if it is smaller than 0.1 there will be no clear direction in the data. These scatterplots will be placed into one of the three following scenarios: (1) there is a positive relation between price and quality'; (2) there is no clear direction in the price-quality relation; and (3) there is a negative relation between price and quality. The results of this test will be processed into the created database. Once the data is included into the database the frequency of each scenario can be requested. We will do this for two different situations. The first being when we include all tenders with at least four bids, the second only the tenders with at least ten bids will be included. In order to find out if there are any significant differences between the number of negative and positive relationships counted a Chi-Square test will be used. Since there is no theory on how the tenders would normally be distributed over the scenarios we assume that after the inconclusive tenders are placed into the second scenario, the number of tenders placed into the first and third scenarios will be equal.

The scatterplots of the overall analysis will help us to decide on which statistical test to use. If the scatterplots show a clear linear correlation a Pearson correlation will be used to measure the direction between price and quality. This coefficient tells to what degree the relationship between quality and price can be represented by a straight line. When the outcome is (-)1 the linear relationship is as strong as it can get, when it is 0 there is no linear relationship according to this statistical method. In case the scatterplots do not show any linearity a Spearman's Rho will be requested. This test is also used in most of the previous price-quality studies (Faulds & Lonial, 2001). If the outcome of this test is (-)1 it has the strongest possible relationship between price and quality, if the outcome is 0 there is no relationship between price and quality according to this measure. To test if the relation is significant a t-test has to be performed. In this test *H0: the correlation coefficient does not differ from 0* will be tested. The outcome of this test tells us what the probability is to find the outcome of the correlation coefficient in case there is no linear relationship between both variables in the population. If the probability is higher than 0.05 *H0* will not be rejected meaning the relationship is not significant.

Besides testing the overall correlation between the price and quality of these bids, the correlation will also be measured per tender. Since it is per tender and the average number of bids per tender is 5.19 the outcome of these tests will most likely be insignificant. Therefor we will just use the direction of the outcome. Again three different situations are created: (1) both tests have an outcome that implies there is a positive correlation between price and quality; (2) both test give a different outcome on the direction of price and quality; and (3) both tests have an outcome that implies there is a negative correlation between price and quality. Again these data will be processed in the created database enabling us to create two frequency tables on how often every situation occurred. The first table will include all tenders having at least four bids, and the second table will include all tenders having at least ten bids. Again a Chi-Square test will be used to test if the number of tenders having a negative correlation is significantly higher or lower than the number of tenders having a positive price-quality correlation. Just like with the scatterplots there is not theory we can base our expected values on. Therefor we assume the counts are equal to each other. This test will most likely back up the conclusions that are drawn on the results on the categorization of the tenders based on the scatterplots.

Since the price-quality correlation might be different for winning tenders a special analysis will be conducted to find out if this is true. First a visualization will help to make assumptions and decide upon a statistical method. Two scatterplots will be created, one for all tenders with at least four bids and one for all tenders with at least ten bids. These scatterplots look the more or less the same as those created to look at the overall relation between price and quality. One thing that is different now is that the winning bids are marked differently than the other bids. This will enable us to see where in the scatterplot the winning bids are scattered the most. To get more grip on the scatterplots some descriptive statistics will be requested. Since we are testing the assumption “winning bids are able of producing high quality products for a low price” we will request the frequencies of: (1) a winning bid that has the best price; (2) a winning bid that has the best quality; and (3) a winning bid having both the best score on price and quality. Unfortunately we will not be able to measure the correlation between price and quality just for these winning bids. They are all winning bids and just comparing all best scores will give a distorted image of the real price-quality correlation.

In the specific analyses we want to compare different groups with each other. The first assumption that will be tested is “the direction of price and quality will be different for products and services”. In order to test this assumption the data will have to be split up into two categories: products and services. For each group the same tests will be performed as in the overall analysis. A frequency table of the scenario’s based on the scatterplots and the directions of the tenders based on the two statistical tests will be requested for each group. In the overall analysis we performed each test in two different situation, the first only included tenders with at least four bids and the second with at least ten bids. This will be hard to do in this situation since the groups will become too small resulting in inconclusive outcomes of the statistical tests. Therefor we will only perform the test for all tenders with at least four bids. After all the counts are known, we will compare the groups with each other using a Chi-Square test for cross tabs. The expected counts will be based on the results of the overall analysis.

In order to test our second assumption “the direction of the price-quality correlation is influenced by the weight of quality” we will create three groups. It is important to make sure the groups will remain large enough to be able to base conclusions on it, the counts in each cell has to be at least five. Therefor we will again only perform the test for the situation where all tenders have at least four bids. A Chi-Square test for cross tabs will be used to test if the groups show significant differences. The expected values of the cells will be based on the result found in the overall analysis.

8. RESULTS OVERALL ANALYSIS

8.1 All bids

To test if the overall price-quality correlation is negative three different measures were used. The first was visualizing all bids using a scatterplot. On this scatterplot the X-axis represents the quality points and ranges from 0 – 100, the Y-axis represents data of the price points and ranges from 100 – 350. The values for both variables are normalized using the formulas mentioned in section six. Some price points scores are higher than 350. These scores are neglected. We assume that these bids are not seriously placed or simply mistakes. For both variables a score of 100 is the best score. Therefor being in the lower right corner is most likely were every organization wants it bid to be. The scatterplot includes two lines. If the dots would have been equally scattered around the blue line there would be a perfectly negative correlation, if the dots would have been equally scattered on the orange line they would have represented a perfectly positive correlation between price and quality.

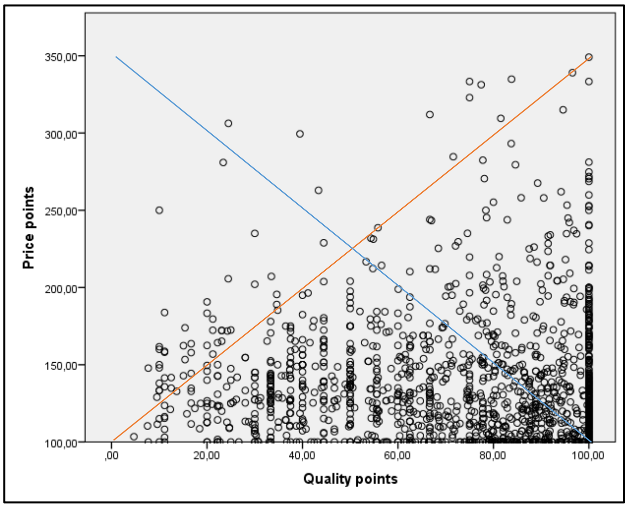

Figure 1

This scatterplot does not show any linearity so a line-of-fit cannot be used to determine if there is a correlation. However there is no linear correlation this scatterplot shows some interesting details. Many dots are scattered in the lowest right corner meaning that there are a lot of bids with a relative high quality and price score. This might be caused by the fact that every tender has a winner which most likely either has a score of 100 on quality or a score of 100 on price, or even both. If only tenders with for example at least ten bids are included, the scatterplot will look quite different. This can be seen in Figure 2.

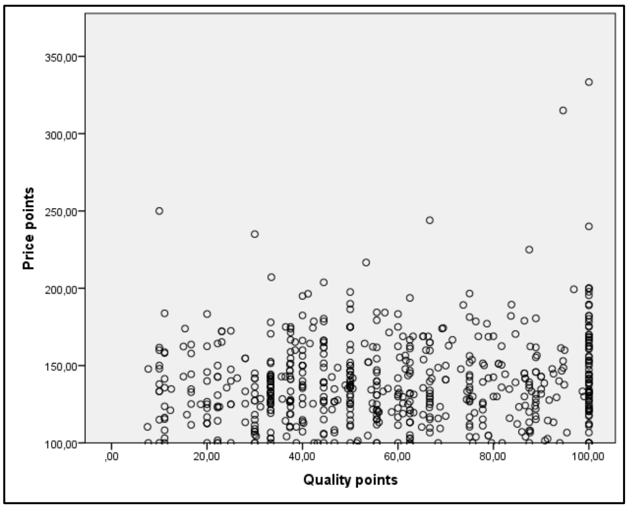

Figure 2

This scatterplot looks more or less similar to the scatterplot in Figure 1. One thing that is different is the fact that less dots are scattered around the axis. Despite that only used tenders with ten bids or more this time, there still is no visible correlation between price and quality.

Since there is no visible linear correlation between price and quality a non-parametric test is used to measure the correlation between price and quality. Again for two different situations to be sure the influence of the winning tender do not influence the outcome of the test too much. If only the tenders with ten bids or more are included $\rho = 0.099$, this outcome is significant since $t = 0.016$. In case the tenders with four bids or more are included $\rho = -0.105$ which is also significant because $t = 0.000$. These results show that in case the influence of the winners is larger the correlation between price and quality becomes more negative.

The second measure that was used is the categorization of the tenders based on three different scenarios. The first scenario shows a positive line in the scatters in the graph, the second scenario shows no line or direction in the graph, and the third scenario shows a negative line of the scatters in the graph. The results of this test especially showed that the more bids a tender has the harder it was to find any line or directions in the graph. Table 1 shows the results for all the tenders having four or more bids, Table 2 shows the results for all the tenders having ten or more bids.

	FREQUENCY	PERCENTAGE
SCENARIO 1	37	18.1%
SCENARIO 2	101	49.5%
SCENARIO 3	66	32.4%

Table 1

	FREQUENCY	PERCENTAGE
SCENARIO 1	3	9.4%
SCENARIO 2	26	81.3%
SCENARIO 3	3	9.4%

Table 2

These tables only give a broad indication of the direction of the relationship between price and quality. Especially the second table gives no conclusive data since most of the tenders, 81.3%, are placed in the second scenario meaning there is no clear direction of the price-quality relationship. Since we already know the Table 2 will not give us any usable data if we perform further analysis on this table, only Table 1 will be used for a further analysis. We are interested in knowing if the difference in number of tenders placed in the first and third scenario is significant. To test that a Chi-Square Test for Goodness-of-Fit will be conducted. There are no records found of similar tests having a theory on how often a tender will have a positive are negative direction of the price-quality correlation. Since we do not compare this situation with another but we just want to know if two values differ within this group of data we assume that normally both scenarios would both have 50% of the left tenders once the tenders belonging in the second scenario are placed in this scenario. So according to the numbers in Table 1 scenario 1 and scenario 3 should both count 51.5 tenders. If we want to use this Chi-Square test we have to make sure the data fits four different conditions. It fits the counted data condition since the data is counted, the independence condition because the tenders do not influence each other, the tenders are randomly selected so it also fits the randomized condition, and last the expected cell frequency condition is also satisfied whereas it is expected to at least have 51.5 counts in each cell. In this test $H_0 =$ there is no significant difference in the number of tenders placed in the first and third scenario and $H_A =$ there is a significant difference in the number of tenders placed in the first and third scenario. Table 3 shows the results of the test. As $3.083 + 0 + 3.083 = 6.166$ $df = 3 - 1 = 2$ P-value $= P(x^2 > 6.165) = 0.05 > P > 0.025$. Therefor we reject H_0. If the assumption we made on the expected counts is true, there is significantly often a negative direction of the price-quality relation of tenders with at least four bids.

	$\boldsymbol{Obs}$	$\boldsymbol{Exp}$	$(\boldsymbol{obs} - \boldsymbol{exp})$	$(\boldsymbol{obs} - \boldsymbol{exp})^2$	$\frac{(\boldsymbol{obs} - \mathbf{exp})\ \mathbf{2}}{\boldsymbol{exp}}$
1	37	51.5	-14.5	210.25	3.083
2	101	101	0	0	0
3	66	51.5	14.5	210.25	3.083

Table 3

Besides looking at a linear direction in the scatterplots two different statistical tests in order to calculate the correlation between price and quality have been conducted or each tender. One parametric and one non parametric tests, respectively the Pearson correlation and Spearman's Rho. Both tests will give an outcome ranging between -1 and 1. A negative outcome means that there is a negative relation between price and quality, a score of 0 means there is definitely no relation and a positive outcome represents a positive relation between price and quality implying that if the price score raises, quality score also raises. Since most of the tenders have too few bids to be able to draw any direct conclusions from the outcome of the tests we will just use these test to determine the direction of the price-quality correlation. If the outcome of both tests reflect a positive correlation between price and quality that tender will be placed in the category 'positive. In case the outcome of both tests are negative that tender will be placed in the category 'negative'. In most of the cases the outcome of the tests will give different results, so it might occur that one test has a positive outcome while the outcome of the other test is negative. In this case the tender will be placed in the category 'different'. Similar like the previous test this tests is conducted in two different situations. First for all tenders with four bids or more of which the results are displayed in Table 4, the second for all tenders with ten bids or more of which the results are displayed in Table 5.

	FREQUENCY	PERCENTAGE
POSITIVE	83	42.9%
DIFFERENT	20	10.1%
NEGATIVE	91	47%

Table 4

	FREQUENCY	PERCENTAGE
POSITIVE	21	65.6%
DIFFERENT	1	3.1%
NEGATIVE	10	31.1%

Table 5

These tables give more information about the direction of the price-quality correlation than Table 1 and Table 2, because most of the tenders which were placed in the second scenario in the first test do show a direction in this test. Just like in the first test we make the assumption that the 'positive' and 'negative' category would count an equal amount of tenders. In table 4 this would be 87 tenders in each cell, in Table 5 this would be 15.5 tenders in each cell. Since the numbers in both cells are different from the values that we would expect we will perform a Chi-Square Test for Goodness-of-Fit to find out if these differences are significant. The following tables and calculations show the outcome of the Chi-Square tests.

$\boldsymbol{Obs}$	$\boldsymbol{Exp}$	$(\boldsymbol{obs} - \boldsymbol{exp})$	$(\boldsymbol{obs} - \boldsymbol{exp})^2$	$\frac{(\boldsymbol{obs} - \mathbf{exp})\ \mathbf{2}}{\boldsymbol{exp}}$

P	83	87	-4	16	0.184
D	20	20	0	0	0
N	91	87	4	16	0.184

Table 6

$0.184 + 0 + 0.184 \approx 0.369$, $df = 3 - 1 - 2$, makes P-value = $P(x^2 > 0.369) = P > 0.10$. The value for P is too large to be able to say that the observed values significantly deviate from the values that we expect. So there are no significantly more tenders having a negative correlation than a positive correlation in case all tenders with four bids or more are included.

	$\boldsymbol{Obs}$	$\boldsymbol{Exp}$	$(\boldsymbol{obs} - \boldsymbol{exp})$	$(\boldsymbol{obs} - \boldsymbol{exp})^2$	$\frac{(\boldsymbol{obs} - \mathbf{exp})\,\mathbf{2}}{\boldsymbol{exp}}$
P	21	15.5	5.5	30.25	1.952
D	1	1	0	0	0
N	10	15.5	-5.5	30.25	1.952

Table 7

$1.952 + 0 + 1.952 = 3.904$, $df = 2 - 1 = 1$, makes P-value = $P(x^2 > 3.904) = p > 0.10$. The value for P is approximately the same as the previous one. Thus, there are not significantly more tenders having a positive than negative correlation in case all tenders having at least ten bids are included in the test. However the differences are not significant the first and second test have some similarities. Both show that if we include all tenders with at least four bids the situation of a tender having a negative correlation has more counts than the situation where a tender has a positive price-quality correlation. This change fades away when only tenders with ten bids or more are included. In the first test the first and third scenario exactly have the same counts and in the second tests there are even more tenders having a positive correlation.

There are significantly more tenders with a negative direction visible in the scatterplot when tenders are used with four bids or more, this is not true when we look at the same test where only the tenders with ten bids or more are used. However the results of the categorization using the directions from the Spearman's Rho and Pearson correlation tests are not significant they show the same results as the categorization based on the scatterplots. Furthermore the overall scatterplot and calculation of the Spearman's Rho also support the outcome of the first test: if tenders are included with four bids or more there is a negative correlation, but if only tenders with ten bids or more are included the correlation between price and quality is positive. The difference in outcome can be caused by several reasons. The first is the influence of the winning tender. Most likely the winning tender has a best score on either price or quality, or maybe even on both. This best score is always 100, also if there are just two competing bids in one tender. Therefor if the tenders are included on the overall scatterplot with few bids, the relative influence of the winning bids become higher than if only the tenders with for example more than ten bids are included. The second is that the tenders who receive many offers have some special characteristics causing it to have a different direction. Both the influence of the winning bids as well as the special characteristics of the tenders will be further analyzed. The last is that it is just coincidence. Only around 30% of the bids are included whilst using only the tenders with ten bids or more.

8.2 Winning bids

Now the overall analysis is done, further deepening can offer some explanations for the results. Some descriptive statistics show how it is systematically more likely for a winning bid having a better quality or price than its competitors. For these descriptive statistics we only use the tenders with at least four bids because the chance that a bid has the best price and quality score is already 25% if a tender only had two bids. The percentages of the total winning bids and other bids having the best quality, a quality score between 90% and 100%, the best price score, and a price score between 100 and 110 can be found in Table 8.

	WINNING BIDS	OTHER BIDS
BEST QUALITY	65.2%	14.7%
QUALITY 90%-100%	82.9%	27.7%
BEST PRICE	61.4%	7.2%
PRICE 100-110	72.9%	17.7%

Table 8

This table shows that winning bids in more than 60% of the tenders have at least a best score on either quality or on price. Data also shows that 30.6% of the times the winning bid has both, the lowest price and the best quality. That value backs up our assumption that organizations responsible for the winning bid are able of producing high quality products for a low price.

In the following scatterplots the black dots represent the winning bids and the blue dots the others. It shows, just like the frequency tables, that the winning bids are scattered around both axis, either having a best score on quality or price, or even both. The tables do show some differences. When we only include tenders with at least ten bids, most winning bids have a best quality score. When also cases with less bids are included, winning bids do also often have a price score of 100.

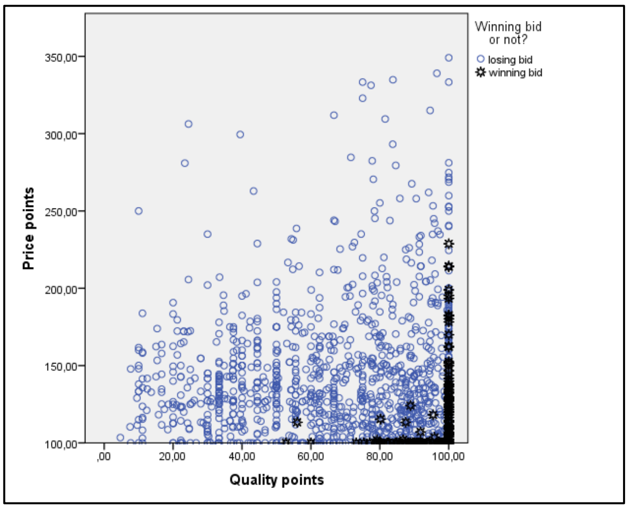

Figure 3

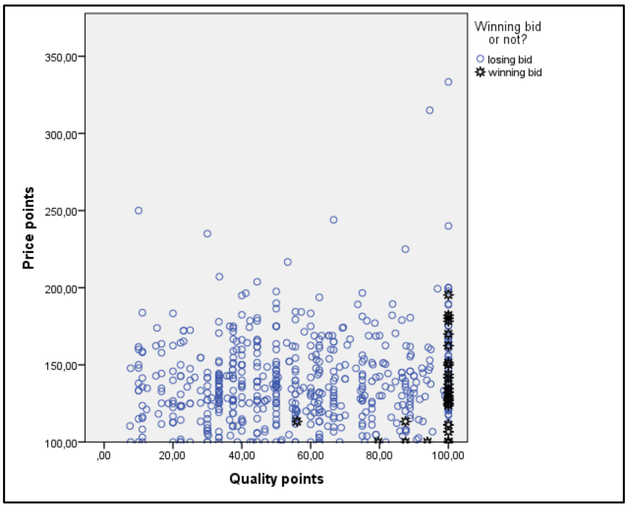

Figure 4

9. RESULTS SPECIFIC ANALYSES

9.1 Service or product

To test if there is a difference in the direction of the price-quality correlation between products and services groups have to be created. Logically, the two groups are called 'products' and 'services, products including all tenders placed for a product and services placed for all tenders for a certain kind of service. How the groups are divided is shown in Table 9. The counts for products are too low if only tenders with at least six or at least ten bids are included. Therefor only the situation where tenders have at least four bids will be used to calculate if there is any difference in the correlation.

	COUNTS, N >= 4	COUNTS, N >= 10	COUNTS, N >=6
PRODUCT	59	3	10
SERVICE	139	27	70

Table 9

First an analysis of all bids in both groups was conducted. For products and services the Spearman's Rho has been calculated. According to this test the correlation between price and quality shows a significantly negative outcome of -0.164. The correlation for services is also negative with a Spearman's Rho of -0.061 but this outcome is not significant. Even though both tests show a slightly different outcome and one is significant while the other is not they both have the same direction, so according to this test there is no reason to think there is a difference between the correlation of price and quality in products and services.

Just like in the overall analysis we will now look at the direction of the correlation per tender. The tenders will be categorized over three different scenarios and three different situations. The categorization of tenders over the scenarios is based on the scatterplots of all tenders. The categorization over the situations is based on the two outcomes of the two statistical tests performed to calculate the direction of the correlation: Pearson Correlation and Spearman's Rho. After the tenders are categorized frequency tables of the number of tenders in each category for both products and services are created. The results of these tables can be found in Table 10 and Table 11. Both tables show that products have more tenders that show a negative correlation than a positive correlation. For services it differs, the first table shows that more tenders have a positive correlation according to the scatterplot, the second table shows that the amount of tenders with a positive and negative correlation are more or less equal to each other. Even though these tables show there are differences in the percentages we cannot say for sure if these differences are significant. To measure the significance of the differences a Chi-Square test for Crosstabs will be performed.

	PRODUCT	SERVICE
SCENARIO 1	16.9%	19.4%
SCENARIO 2	39.0%	51.8%
SCENARIO 3	44.1%	28.8%

Table 10

	PRODUCT	SERVICE
POSITIVE	33.9%	46.5%
DIFFERENT	13.6%	8.5%
NEGATIVE	52.5%	45.5%

Table 11

Table 12 and Table 13 show the observed in expected counts of tenders per scenario and category for products and services. The expected values are calculated using the percentages calculated in the overall analysis. For example the expected value for products in 'scenario 1' is calculated the following: $0.181 \times 59 = 10.679 \approx 11$. From now on the calculation will be exactly the same as the earlier performed Chi-Square test.

	PRODUCT		SERVICE	
	OBS	**EXP**	**OBS**	**EXP**
SC. 1	10	11	27	25
SC. 2	23	29	72	69
SC. 3	26	19	40	45

Table 12

$\sum \frac{(obs-\exp)2}{exp} = 4.758$, $df = (3-1)(2-1) = 2$, makes P-value = $P(x^2 > 4.758) = 0.1 > p > 0.05$.

	PRODUCT		SERVICE	
	OBS	**EXP**	**OBS**	**EXP**
P	20	25	64	60
D	8	6	12	14
N	31	28	63	65

Table 13

$\sum \frac{(obs-\exp)2}{exp} = 2.604$, $df = (3-1)(2-1) = 2$, makes P-value = $P(x^2 > 2.604) = p > 0.1$.

Not one of these tables shows a significant difference between the tenders divided over the three scenarios and situations. The calculation of the Spearman's Rho validates these findings since the calculated Spearman's Rho of the products and services do not show big differences. So according these statistics there is no reason to assume that there is a significant difference between the direction of the price-quality correlation of products and services. However these findings do not show any significant deviations, we have to keep in mind that the influence of the bids and other factors have not been taken into account.

9.2 Weight of quality

Before we are able to discuss the influence of the weight of quality the price-quality correlation we have to create equal groups that help to find evidence which backs up or rejects our assumption. This assumption is based on the equality of the weights, if the weight of price and quality are about equal to each other the price-quality correlation will be more negative than if price or quality has much more higher weight than the other. Therefor we will split the data into three different groups, the first having a quality weight ranging from 0% until 33%, the second having a quality weight ranging from 34% until 67% and the last having a quality ranging from 68% until 100%.

First the number of tenders in each category where counted for the two different situations continually used throughout this research. The results are presented in Table 11. The number of bids has influenced the outcome of the tests. For that reason we have to pay attention that if only tenders with four bids or more are included, 36% of the tenders placed in the third group has at least ten bids or more. In comparison to the other groups this is a large share, the second group only 8.8% of the tenders has ten bids or more and in the first group this is 0%. Therefor it might be that not the influence of the weight of quality is causing the difference but the influence of the number of bids. However, this can also be the other way around. The weight of quality has been influencing the outcome of the tests instead of the number of bids. Another conclusion that can be drawn from this table is that using the situation of at least ten bids is useless since the first category has no counts. As we wanted to take the influence of the number of bids into account also the counts of tenders in each category of all tenders with at least six bids are displayed in Table 11. The first group is still too small to base any conclusions on, so only the situation with at least four bids per tender will be used.

RANGE QUALITY WEIGHT	COUNTS, N >= 4	COUNTS, N >= 10	COUNTS, N >=6
0%-33% (1)	22	0	6
34%-67% (2)	124	11	45
68%-100% (3)	58	21	34

Table 14

For each group the Spearman's Rho will be calculated to get a first impression on the direction. The first group has an insignificant negative correlation with Rho of -0.047, the second group showed a significant negative correlation with a Rho of -0.145, and the third group showed a significant positive correlation with a Rho of 0.111. The results of these tests are somewhat like we expected. The second groups shows a more negative correlation than the first and third group. What we did not expect was the third group showing a more positive relationship than the first.

	0-33	34-67	68-100
SCENARIO 1	18.2%	16.9%	20.7%
SCENARIO 2	40.9%	46.0%	60.3%
SCENARIO 3	40.9%	37.1%	19.0%

Table 15

	0-33	34-67	68-100
POSITIVE	45%	38.1%	51.8%
DIFFERENT	5%	13.6%	5.4%
NEGATIVE	50%	48.3%	42.9%

Table 16

Table 15 and Table 16 show the results of the second measure we used to find a difference in the direction between price and quality. Table 15 represents the results of the categorization of the tenders based on the scatterplots and Table 16 of the categorization based on the outcome of the Pearson Correlation and Spearman's Rho of the tender. Both tables show the some outcome on the direction as the calculation of the Spearman's Rho did. The first two groups have more negatively correlated tenders in both tables, the third group has more positively correlated tenders in both tables. A Chi-Square test will be conducted to measure the significance of the differences. Table 17 and Table 18 show the observed in expected counts of tenders per scenario and category for each group. The expected values are calculated using the percentages calculated in the overall analysis. For example the expected value for group 1 in 'scenario 1' is calculated the following: $0.181 \times 22 = 3.982 \ \approx 4$. From now on the calculation will be exactly the same as the earlier performed Chi-Square test.

	0-33		34-67		68-100	
	OBS	**EXP**	**OBS**	**EXP**	**OBS**	**EXP**
SC. 1	4	4	21	23	12	10
SC. 2	9	11	57	61	35	29
SC. 3	9	7	46	40	11	19

Table 17

$\sum \frac{(obs-\exp)2}{exp} = 5.813, \ \ df = (3-1)(3-1) = 4,$ makes P-value = $P(x^2 > 5.813) = p > 0.1$.

	0-33		34-67		68-100	
	OBS	**EXP**	**OBS**	**EXP**	**OBS**	**EXP**
SC. 1	9	9	45	51	29	24
SC. 2	1	2	16	12	3	6
SC. 3	10	9	57	55	24	26

Table 18

$\sum \frac{(obs-\exp)2}{exp} = 8.69, df = (3-1)(3-1) = 4,$ makes P-value = $P(x^2 > 8.69) = 0.1 > p > 0.05$.

Due to the large values for P in both tables the outcome the differences are not significant. However this one test did not show any significance in deviation between the three groups, all tests show the same results that do indicate a difference between the three groups. Every time the direction of the first two groups was negative while the direction of the third group has been positive. So just because the test did not show any significance we cannot just assume there is none. Furthermore we have to be careful in drawing conclusions since the third category has a large percentage of tenders having ten bids or more. 67% of the tenders with ten bids or more are placed in this category. Thus it is possible that the differences are caused by the number of bids instead of by the influence of the weight of quality.

Besides the tests of the direction of the price-quality correlation we were also interested to know if the percentage of winning bids having both the best price and quality was larger for the second group than for the other two groups. Table 19 shows some values that help to answer that question. It shows that the percentages for the first two groups are almost equal to each other. Furthermore these percentages are larger than for the third group. In this test the influence of bids influences the chance of having both the best price and quality score, because achieving that will be easier if there are just three other organization competing instead of more than ten. Therefor conclusions based on this Table should be not be taken into account too heavily.

	Number of tenders	% of tenders having a winning bid that has the best price and quality.
0%-33%	22	36.4%
33%-67%	124	36.3%
68%-100%	58	17.2%

Table 19

10. DISCUSSION

This research attempted to answer the following research question: *"What is the direction of the price-quality correlation of bids in tenders in The Netherlands?"*. Several tests on the price-quality correlation were carried out in order to provide an answer to this question. Each test is performed in several situations and gives information on the different propositions mentioned in this research. The outcome of the tests in general show that, if only tenders with at least four bids are included in the statistical tests, the overall price-quality correlation is negative with a value for the Spearman's Rho of $-.105$. Only taking this measure into account would direct us to state the price-quality correlation is negative. However, if the same statistical tests are performed only on tenders with at least ten bids, the direction of the correlation is positive with a value for the Spearman's Rho of 0.016. The deviation in the outcome of these two tests causes it to be impossible to give one straight conclusive answer on the research question.

The dispute on the direction of the correlation between price and quality exists ever since studies are conducted within this field. Even though many studies have found a positive correlation between price and quality (Gerstner, 1985; Oxenfeldt, 1950; Riesz, 1979; Tellis & Wernefelt, 1987; Vlaev et al., 2009), some studies managed to find a negative price-quality correlation for several product categories (Curry & Riesz, 1988; Lichtenstein & Burton, 1989). The reason provided for the negative correlation differs with the one we believe might be true. The studies which have found a negative correlation mention this is caused by an imperfect market (Curry & Riesz, 1988; Lichtenstein & Burton, 1989). We made the assumption that a negative correlation is either caused by a well-designed production process enabling an organization to produce high quality products for a lower price or by a good brand image of which the customers are aware causing them to be more willing to wait for the products which results in lower inventory costs and having less advertisement costs. This will result in lower costs while the company still produces high quality products. The results of this research are not able to give an answer on which one of these is true, but this is one important difference between this study and all previous studies on the price-quality relation.

This study does corroborate the fact that previous studies often showed a variety of outcomes on the Spearman's Rho tests over product categories and even studies in general. Like the other studies, this study showed differences between the general analyses of the price-quality correlation if all tenders with at least four bids were included and if only tenders with at least ten bids were included. Furthermore the specific analyses showed differences in the significance of the analyses as well as the direction of the correlation.

At the beginning of this research we did not expect the outcome of the Spearman's Rho calculated for the two different situations, one with all tenders with at least four bids, the other only with tenders having at least ten bids, would show differences this big. In the first situation the outcome is significantly negative (-0.105), in the second situation the outcome is significantly positive (0.016). A possible explanation might be the influence of the winning bid. This winning bid most likely has a relatively good price and quality score in comparison to the other bids. In case there are just a few bids on the tender, the chance a winning bid has the best score on price and quality is higher than when a tender has received over ten bids. However one third of the tenders with ten bids or more have a weight of quality larger than 68%. The weight of quality can also explain why many of these tenders do not have a negative correlation. Since quality is the most important factor, most organizations will just focus on this aspect and prices do not really matter. Therefor the prices will vary while the quality scores are close to each other, resulting in more random scatters and thus a less negative correlation. Unfortunately this study was not able of finding the true reason for the differences in the price-quality correlation in these two situation.

Another unexpected outcome is the fact there is no significant difference in the direction of the price-quality correlation between products and services, and between three different groups based on the weight of quality. One of our believed reasons which might explain a negative correlation between price and quality is a well-structured production process resulting in an ability of the organization to produce high quality products at low production costs. A production process, with few exceptions, is more important for products than for services. According to our theory, the price-quality correlation should be more negative for products than for services. Even though every test conducted showed a slightly more negatively price-quality correlation for products, the differences were not significant. The Spearman's Rho for products is -0.164, for services -0.061. In the categorization of the tenders based on the scatterplots 44.1% of the product tenders show a negative correlation towards 28.8% of tenders placed for services. The categorization of tenders based on the outcome of the Pearson Correlation and the Spearman's Rho showed that 52.5% of the product tenders have a negative correlation towards 45.5% of the service tenders.

The weight of quality was another variable based on which the tenders were divided into three different groups. The first group included all tenders with a quality weight ranging from 0% through 33%, the second group ranging from 34% through 67%, and the third group ranging from 68% through 100%. We assumed that if the weight of quality and price are about equal to each other, organizations have its focus on optimizing both the price and quality score. Thus price and quality would be more negatively correlated. If the price or quality has a stronger weight than the other, the focus of an organization, which is going to place a bid, is on optimizing the factor with the highest weight. Results showed that the first two groups have a negative correlation and the third group has a positive correlation. Even though the Chi-Square test pointed out these differences are insignificant, this is not a reason to assume there is no difference between the groups since all three test show the first two groups have a negative correlation. The results of the Spearman's Rho test are respectively -0.047 and -0.145 while the third group has a positive correlation of 0.111. However the groups do differ from each other, even though the differences are not significant, we cannot say for sure that the differences are caused by the weight of quality. The categorization is influenced by the number of bids, since 67% of all tenders with ten bids or more are placed in the third group, and the rest in the second. So the differences can also be caused by the number of bids on a tender.

Another assumption that has been made was the ability of an organization that placed the winning bid to produce high quality products at low costs. Some notable findings that help building evidence to back up this assumption are the fact that all tenders with at least four bids 30.6% of the tenders has a winning bid that both has the lowest price and the highest quality score. Furthermore, more than 60% of the winning tenders has either the highest quality score, the best price score, or even both.

Unfortunately this research has its limitations. We received few background information on the randomness of the database. If we had received a database with other tenders, it could have been that the outcome would have been completely different. The dataset was also rather small and included many tenders with less than 5 bids. This made it hard to divide the tenders into groups and still be able to perform reliable tests. Furthermore, not all variables that might have influence on the price-quality correlation were included in this research. Therefor wrong conclusions on the influence of the included variables might have been made.

Besides the limitations caused by the database, there are other factors that are also putting limitations on this research. The bidding behavior of organizations influences the outcome. Some bids might not be reliable because organizations do not have enough time to create a good offer, so they just place a bid. Due to the few bids per tender, these bids have a large influence on the correlation between price and quality within that tender.

Because of the differences in outcomes and these limitations, this research does not provide any conclusive outcomes. However the results are not conclusive now, the results can be after further research is conducted. This research did not provide answers on the question why the correlations variate between the situations of including all tenders with four bids or more and including only tenders with at least ten bids, between products and services and between the groups based on the weight of quality. Further research can be conducted to find an answer to this question. Besides, this research does not give any information whether our assumption on why some tenders might have a negative correlation is true. Another study can be conducted to find out if the reason that some organizations are able to provide high quality products for a low price is a well-structured production process or a good brand image. Since this research only includes few variables on the price-quality correlation it would be interesting to perform further research the influence of other variables like economical background of the organization, location of the organization, scale of the organization, brand image of the organization, etc. To measure the overall price-quality correlation in tenders, a larger dataset including more tenders with a higher average of bids would help, because the influence of other variables will be less likely. Lastly further study has to be conducted to find out if the findings of these tests are generalizable for products that are not acquired via tenders.

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